

**Final Performance Report**

This template is aimed to provide a summary of the performance results achieved against the targets identified in the work plans for the Contribution Agreement (CA) and the Collaborative Research and Development Agreement (CRDA) during the entire life of the activity/project.

Please write for a general audience using plain language. Do not include sensitive or confidential information.

Name of Recipient: Canola Council of Canada	
Project Title: Agri Innovation Program Steam B	
Project Number: AIP-P353	Period Covered by Report: 2013-04-01 to 2018-03-31
Activity #: 7.v1 – 2015.27 Name of Activity: To germinate or not to germinate? - Towards understanding the role dormancy plays in canola seed and seedling vigour and stand establishment	Principal Investigator: Dr. Sally Vail, AAFC Saskatoon
Start Date (YYYY-MM-DD): 2015-04-16	End Date (YYYY-MM-DD): 2018-03-31

1. Summary of Performance Results for the entire life of the activity/project**Targets:**Objectives

Title: This project will characterize both commercial hybrids as well as a set of diverse *Brassica napus* lines for precocious germination, primary and secondary dormancy potential of mature seed as well as seed and seedling vigour potential. In ad

Status: Met

Health: Green

Description: This project will characterize both commercial hybrids as well as a set of diverse *Brassica napus* lines for precocious germination, primary and secondary dormancy potential of mature seed as well as seed and seedling vigour potential. In addition to genotypes, different treatments will be seedlots derived from contrasting environments and storage treatments.

Outcome: Results will expand the understanding of *B. napus* seed biology and how it relates to genetic traits associated with stand establishment and the potential for induction of secondary dormancy.

Performance Assessment/Variance: This project has progressing well and has resulted in the discovery of new, valuable information about seed quality and vigour and relationship to secondary dormancy potential in canola.

Milestones

Title: Bridging genomic and phenotypic data

Assigned To: Sally Vail

Start Date: 2017/04/01

End Date: 2018/03/31

Status: In Progress



Activity: Bridging of genomic data and phenotypic values on seed biology.

Milestone / Deliverable: A preliminary understanding of associations between genomic regions and dormancy, stand-establishment and seed quality related traits.

Progress Assessment/Variance: Fully analyzed data from screening seedlots for secondary dormancy as well as other seed quality parameters or traits will be available within the next few months as the final report is being prepared for the industry partner. Once these results are curated, GWAS analyses will be initiated.

Title: Commercial Partners

Assigned To: Sally Vail

Start Date: 2016/01/29

End Date: 2016/03/31

Status: Completed

Activity: Identify commercial seed production partners

Milestone / Deliverable: Identification of at least two commercial seed production partners

Progress Assessment/Variance: Various contacts were made in Fall of 2015 and Dr. Vail has discussed the project concept with four industry collaborators from companies where existing complimentary collaborations exist.

For this project, MTAs with 2 companies were signed. Screening of seedlots from these companies is completed. In addition to the engaged parties, Dr. Vail has met multiple times with several other potential industry partners on this portion of the project, including hybrid seed producing companies and seed testing laboratories.

Title: Commercial seed and conditions screening

Assigned To: Sally Vail

Start Date: 2017/04/01

End Date: 2018/03/31

Status: Completed

Activity: Assessment of dormancy induction on the thermal gradient plate using environmental data obtained in 2016-17. Screening commercial seedlots for change in dormancy induction potential.

Milestone / Deliverable: Data to support hypotheses surrounding the dormancy and secondary dormancy induction potential within commercial seed production systems.

Progress Assessment/Variance: This experiment has been completed and the results are currently being analyzed. We were able to get some really good input on defining our temperature treatments for this experiment from a Canola Council agronomist who focuses on harvest management and storage conditions as well as one of Canada's most experience hybrid seed production managers.

Title: Commercial seed and environmental data

Assigned To: Sally Vail

Start Date: 2016/04/01

End Date: 2017/03/31

Status: Completed

Activity: Work with seed production partners to obtain commercial seed from Canadian and/or contra-season sites. Work with commercial seed production partners to track environmental data of seedlots during storage and/or shipment from contra-season.

Milestone / Deliverable: Valuable data and seedlots to develop a series of smaller experiments to examine secondary dormancy potential in commercial production systems.



Progress Assessment/Variance: These experiments are completed. There was an opportunity to share preliminary results with one of the two companies we are working with and they were quite interested in our results and renewed the MTA providing us more seed samples to screen to further test our working hypothesis.

Title: Protocols

Assigned To: Sally Vail

Start Date: 2016/01/29

End Date: 2017/03/31

Status: Completed

Activity: Establish routine dormancy screening procedures and develop protocols for dormancy testing on the thermal gradient plates

Milestone / Deliverable: Utilization of standard protocols producing reliable data and development of new approaches using the thermal gradient plate

Progress Assessment/Variance: Primary and secondary dormancy screening has commenced. Suitable space for performing screening at AAFC-SRDC has been identified.

Title: RIL Seed Production

Assigned To: Sally Vail

Start Date: 2017/04/01

End Date: 2018/03/31

Status: Completed

Activity: Production of seed from selected NAM RI lines at a Canadian site.

Milestone / Deliverable: Seed for future testing of secondary dormancy potential.

Progress Assessment/Variance: Harvested seed is currently curated and stored in a freezer for future screening of secondary dormancy potential as proposed in the next Canola Cluster. There is great concern if funding for this work is delayed as we need to initiate screening of this seed as soon as possible as we know the secondary dormancy potential of stored seed decreases over time at different rates depending on the genotype of the line. Re-doing this increase would be quite cost prohibitive and wasteful in the case where delay in continuing funding for this work occurs.

Title: Seed Production

Assigned To: Sally Vail

Start Date: 2016/01/29

End Date: 2017/03/31

Status: Completed

Activity: Grow NAM founder lines at a Canadian and contra-season site

Milestone / Deliverable: Seedlots from Canadian and contra-season sites

Progress Assessment/Variance: Seed from contra-season environments was delivered in 2016.

Title: Seed and Seedling Analysis on Founders

Assigned To: Sally Vail

Start Date: 2016/01/29

End Date: 2017/03/31

Status: Completed

Activity: Testing for Associations between Dormancy and Other Seed and Stand-Establishment Related Traits



Milestone / Deliverable: Data and associations on Precocious Germination, Seedling Vigour and Seed components

Progress Assessment/Variance: All screening is completed. Multi-season results are now being analyzed by the MSc student working on the project.

Title: Staffing

Assigned To: Sally Vail

Start Date: 2016/01/29

End Date: 2016/03/31

Status: Completed

Activity: Identify technical support and graduate student for the project

Milestone / Deliverable: Hiring technical support and graduate student for the project

Progress Assessment/Variance: Suitable staff has been identified and is in place.

Results Achieved:

Results from this project show a very wide range in SDP across a spring *B. napus* diversity collection with several high SDP lines being much greater than those identified in the earlier studies. Additionally, the effect of seed production sites was evident, especially for a subset of diverse lines which exhibited contrasting SDP between sites. The SDP values for all seedlots have been compared to total germination, rates of germination, primary dormancy, seed vigour measurements (controlled deterioration test and pre-chill germination test) seed size and precocious germination. No association between SDP and any of these other germination or seed vigour parameters have been found. Thus, our results indicated that SDP is independent of routinely employed assessments or measurements of seed vigour. These results also lay the groundwork to study the genetics controlling SDP.

In order to test the relevance of our findings to the commercial hybrid seed production industry, we initiated two smaller studies looking at i) the effect of temperature regimes that commercial hybrid seed is exposed to after harvest until the point of sale to the grower on SDP; and ii) SDP of commercial seedlots from different seed production environments. Examination of 12 extreme temperature regimes imposed on seed of high and low SDP lines confirmed that SDP decreases over time and with exposure to non-freezing temperatures and that none of the consistent or varied temperature regimes increased the SDP of seedlots. Examination of 30 commercial seedlots of hybrid canola have confirmed that variation within breeding programs exists for SDP and that for high SDP varieties, seed production environment contributes to significant increases of SDP for a given seedlot. These results will be of value for the canola seed production industry in prioritizing selection for decreased SDP in commercial varieties and could have implications on seedlot blending and/or seeding rate recommendations.

Explain any variance: n/a

Performance Measures	Targets	Results Achieved	Explain any variance between targets and results achieved. Use plain language.
# of Intellectual property items flowing from the project			
# of new/improved products			
# of new/improved processes or			



systems			
# of new/improved practices		1	Our results have resulted in the demonstration of need for screening for secondary dormancy potential (SDP) in commercial seedlots. Currently, standard germination and seed vigour testing are routinely performed. We tested these 'standard' protocols and compared them to screening for SDP on the same seedlots and found the results of the standard protocols were all highly correlated or predicted results of a parallel protocol; however, the SDP screening was not related to the standard protocols. Furthermore, we demonstrated that in some commercial seedlots, a significant portion of the seed has potential to be induced into secondary dormancy. We are working with hybrid seed producers and commercial seed testing facilities to re-examine seeding rate and blending recommendations based on these results.
# of new varieties			
# of new/improved genetic materials		1	We have identified new check lines of <i>Brassica napus</i> to use for secondary dormancy screening. Previously, little was known of consistent high/low checks other than results reported in the early 2000s. By screening a diversity collection that was produced in more than four environments, we established a collection of lines (6 in total) that produce consistently high SDP and contrasting low SDP regardless their maternal environment. The lines with the consistently high SDP phenotypes are much larger and more consistent than lines previously reported. We anticipate providing seed of these lines for use as checks in commercial seed testing laboratories and to hybrid production companies.
# of new/ improved gene sequences			
# of improved knowledge		4	1. Discovery of variation across spring <i>Brassica napus</i> for Secondary Dormancy Potential (SDP), including quantification of a range of phenotypes given varied maternal environments. 2. Discovery of lack of association between precocious germination, primary dormancy and seed vigour with SDP. 3. Confirmation of various commercially-relevant temperature variations reducing SDP of commercial seedlots. 4. Testing of commercial seedlots showed SDP variation between varieties and maternal production environments.



2. New/Improved Products: Of the new/improved products developed and reported above during the project, which products have commercial potential? Which have been commercialized? And which have been used/adopted by the sector? Explain what stage each product is at and the impact on the sector.

New/Improved Practice: Screening for SDP in Commercial Seedlots and Recommendations

- This is a Knowledge and Technology Transfer opportunity rather than a commercialization opportunity. The screening protocols are publically available and relatively easy to implement. Follow-up experiments to further quantify the nature of the results we observed to develop recommendation strategies are required. With this, it is highly likely the additional SDP screening methodology will be adapted by seed testing laboratories and canola hybrid seed production units of seed companies.

New/Improved Genetic Materials: High and Low SDP Check Lines

- These lines are proprietary to AAFC and are part of a collection that is typically provided without fees upon request through an MTA. Given the narrow range of use for these particular lines with minimal seed requirements, it is unlikely there would be a commercial partner interesting in licencing these lines for seed production and sales. That being said, a business plan for consistent regeneration of fresh pure seedlots and inventory maintenance would be required.

Improved Knowledge: Variation Across Spring *Brassica napus*

- These results lay the groundwork to study the genetics of SDP which would result in the identifications of molecular-markers which would have commercialization potential for canola seed companies.

Improved Knowledge: Temperature Variations Reducing SDP of Commercial Seedlots

- This is a Knowledge and Technology Transfer opportunity rather than a commercialization opportunity.

3. What is your target audience for sharing information about the results of your project? Describe your strategy and success in reaching this target audience.

Academic Brassica and Seed Biology Researchers:

- Expected 2-3 scientific publications to be submitted in 2018:
 1. Range in secondary dormancy potential across diverse lines of spring *Brassica napus* produced in different environments and relationship to primary dormancy, germination and seed vigour
 2. Genome-Wide association mapping for primary and secondary dormancy potential and seed germination and vigour (tentative pending results)
 3. Impact of pre-induction temperature on seed of diverse lines of *Brassica napus* with contrasting secondary dormancy potential
- Possible Conferences/Symposia/Workshops:
 - 6th Plant Dormancy Symposium, 23-26 October 2018, Kyoto, Japan
 - Plant Dormancy Workshop, Plant and Animal Genome Conference XXVI, 13-17 January, 2019, San Diego, USA
 - 15th International Rapeseed Congress, 16-19 June 2019, Berlin, Germany



- 6th Workshop on the Molecular Aspects of Seed Dormancy and Germination, 2020

Canola Breeding Companies:

- Reports and one-on-one meetings with collaborators from this project
- Possible attendance of the Hybrid Crop Sub-Committee of the Canadian Seed Trade Association Annual or Semi-Annual meeting, July 2018
- Possible presentation at Canola Forum and/or Canola Industry or Innovation Day, Fall 2018

Commercial Seed Testing Laboratories:

- A report and follow-up meetings to discuss results
- Possible attendance of the Canadian Seed Trade Association Annual or Semi-Annual meeting, July 2018